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non-radial effects occur in a systematic manner and not accidentally as they would if they were purely observational errors. He also finds that for the same distance a star in the polar regions of the sun showed a somewhat larger displacement than one in the equatorial regions. The question is raised, among others, how completely it was possible in the British observations to eliminate differential refraction effects as the rays passed through the earth's atmosphere.

Dr. Bauer's expedition was one of several expeditions sent out by the Department of Terrestrial Magnetism of the Carnegie Institution of Washington to make geophysical observations, the data from which are proving of interest in the discussion of the possible disturbing effects on the observed deflections of light. He himself observed the memorable eclipse at Cape Palmas, Liberia, where totality lasted longer, 6 minutes and 33 seconds, than at any other accessible station. He characterizes this eclipse as the most magnificent one of the four he has thus far observed; not only was the corona beautifully and finely developed but also a striking crimson prominence appeared on the sun's southeast limb which shot up 100,000 miles and had a base of 300,000 miles.

Dr. Bauer concludes with reference to the observed light deflections that "the best attitude to take is that of open-mindedness and to let no opportunity pass by for further experimental tests," and that "one of the most satisfactory results has been the stimulus imparted to further research in many fields which is bound to bear fruit."

PROFESSOR EINSTEIN ON THE THEORY OF RELATIVITY

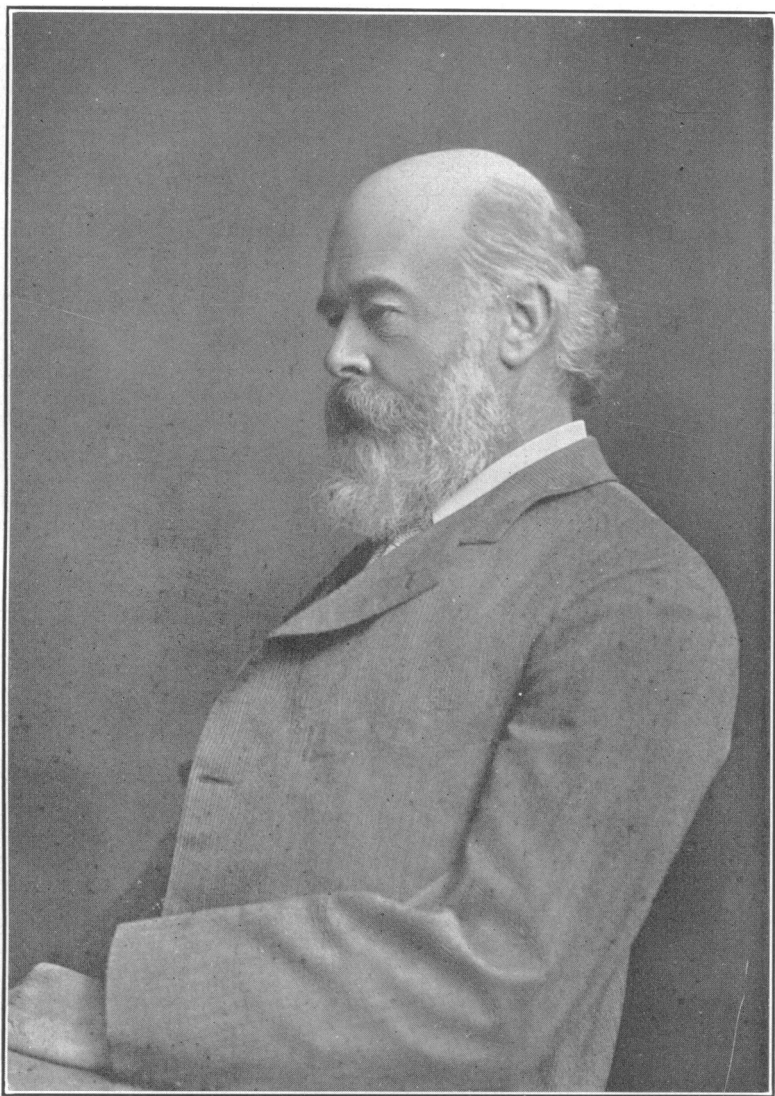
IN an article contributed to the *London Times*, Professor Albert Einstein has undertaken to present his

theory of relativity in a form comprehensible to readers not trained to think in mathematical formulas. He calls attention to the fact that the ancient Greeks knew that the motion of a body must be described in reference to another body. In physics the bodies to which motions are spatially referred are termed systems of coordinates. The laws of mechanics of Galileo and Newton can be formulated only by using a system of coordinates.

The special relativity theory is the application of the following proposition to any natural process: "Every law of nature which holds good with respect to a coordinate system K must also hold good for any other system K' provided that K and K' are in uniform movement of translation." According to the Maxwell-Lorentz theory of electro-dynamics, however, light in a vacuum has a definite and constant velocity, independent of the velocity of its source.

These two principles have received experimental confirmation, but do not seem to be logically compatible. The special relativity theory achieved their logical reconciliation by making a change in kinematics, that is to say, in the doctrine of the physical laws of space and time. It became evident that a statement of the coincidence of two events could have a meaning only in connection with a system of coordinates, that the mass of bodies and the rate of movement of clocks must depend on their state of motion with regard to the coordinates.

But the older physics, including the laws of motion of Galileo and Newton, clashed with the relativistic kinematics. Physics had to be modified. The most notable change was a new law of motion for very rapidly moving mass-points, and this soon came to be verified in the case of electrically-laden particles. The most important result of the special relativity system concerned the inert



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mass of a material system. It became evident that the inertia of such a system must depend on its energy-content, so that we were driven to the conception that inert mass was nothing else than latent energy. The doctrine of the conservation of mass lost its independence and became merged in the doctrine of conservation of energy.

The special relativity theory which was simply a systematic extension of the electro-dynamics of Maxwell and Lorentz, had consequences which reached beyond itself. Although it may be necessary for our descriptions of nature to employ systems of coordinates that we have selected arbitrarily, the choice should not be limited in any way so far as their state of motion is concerned. This general theory of relativity was found to be in conflict with a well-known experiment, according to which it appeared that the weight and the inertia of a body depended on the same constants.

A generalized theory of relativity must include the laws of gravitation, and actual pursuit of the conception has justified the hope. But the way was harder than was expected, because it contradicted Euclidian geometry. In other words, the laws according to which material bodies are arranged in space do not exactly agree with the laws of space prescribed by the Euclidian geometry of solids. This is what is meant by the phrase "a warp in space." The fundamental concepts "straight," "plane," etc., accordingly lose their exact meaning in physics.

In the generalized theory of relativity, the doctrine of space and time, kinematics, is no longer one of the absolute foundations of general physics. The geometrical states of bodies and the rates of clocks depend in the first place on their gravitational fields, which again are produced by the material systems concerned.

Thus the new theory of gravitation diverges widely from that of Newton with respect to its basal principle. But in practical application the two agree so closely that it has been difficult to find cases in which the actual differences could be subjected to observation. As yet only the following have been suggested: (1) The distortion of the oval orbits of planets round the sun (confirmed in the case of the planet mercury). (2) The deviation of light-rays in a gravitational field (confirmed by the English Solar Eclipse expedition). (3) The shifting of spectral lines towards the red end of the spectrum in the case of light coming to us from stars of appreciable mass (not yet confirmed).

Professor Einstein says in conclusion: "The great attraction of the theory is its logical consistency. If any deduction from it should prove untenable, it must be given up. A modification of it seems impossible without destruction of the whole. No one must think that Newton's great creation can be overthrown in any real sense by this or by any other theory. His clear and wide ideas will for ever retain their significance as the foundation on which our modern conceptions of physics have been built."

SCIENTIFIC ITEMS

WE record with regret the death of Francis C. Phillips, for forty years professor of chemistry at the University of Pittsburgh; of Alfred J. Moses, professor of mineralogy in Columbia University; of Edwin A. Strong, emeritus professor of physics at the Michigan State Normal College; of Sir James Alexander Grant, the Canadian surgeon and paleontologist; and of two of the most distinguished German men of science, Wilhelm Pfeffer, the botanist of the University of Leipzig, and of Otto Bütschli, the zoologist of the University of Heidelberg.